



***The NASA Glenn Research Center  
Macintosh User Group***

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Well, if you missed this one, you missed a great demo from Apple Computer...plus FREE pizza. We managed to squeeze over 100 mac enthusiasts into the TDC room in the RAC building on August 9th. We kept them there with pizza and soda and a GREAT presentation by **Jacques Jordain** of Apple. While they did not bring a real cube or cinema display, the slide presentation was very well done. Jacques promises next time they'll have some actual hardware for us to oooh and ahhh over. That would be nice.

A special thanks to **Chris Lynch** of our photo imaging lab for taking some digital shots of the event, which you may check out inside this newsletter. See if you can spot yourself or someone you know. I think you will find a few PC folks there as well!

We had some software to give away, plus Apple brought a truck load of orange pens and some very snazzy T-shirts.

It is nice to have the door prizes, but they are getting harder to come by since we have a zero budget. So, if you see any ads offering FREE software, hardware, books, anything computer related from your local computer store, please think of the group, okay? Microcenter often has such FREE items, just so you know.

We also need more people to review software they currently use. Tell us what you do with your Mac. Believe me, we want to know!

Our next user group meeting will be held toward the end of October. We do not have a date as of this newsletter, sorry, because we are trying to get someone from Parallel Software to come out to do a demo. They've offered to buy us lunch, so we want to accomodate them as much as possible! Please keep an eye out for an email from the mac user group, letting you know exactly when the next meeting will be, and we hope to see you there.

—Lisa Madden, editor

# President's Corner

## Macs in Science and Engineering

From time to time, I'd like to contribute a little column to the newsletter on the things I am working on behind the scenes. For this month's column, I'd like to talk a little about the work I have done with the Macs in the Science and Engineering fields.

Last month I posted a message to the evangelist (see below) email listing about the poor showing of Apple when it comes to supporting S&E areas. I was flooded with responses from other NASA folks, other government Lab folks, and just a bunch of engineers and scientists. We are not alone.

As a result, I have added a page to our web site called *Science and Engineering*. I will be posting Mac-related sites with an S&E concentration to them, as well as software manufacturers, such as Absoft, who support our area. But the best part of this page is a part I didn't expect to be adding. I have now put up links to other NASA MUGs as well as other Government Labs MUGs. Hopefully we can get all of the MUGs to sort of work together. I have already established ties with the head Mac person on the ODIN contract at GSFC, the president of the Ames Mac Users Group, as well as the new president of the MUG at Johnson – Yes, the Macs have returned to JSC!

So, stop on by to either our internal page or the public version and take a look. Feel

free to add stuff as you see fit. There's always room for more! Looks like a good time for Macs in our technical fields.

—Melissa McGuire, President

Links:

MacEvangelist—

<http://www.MacEvangelist.com/>

Internal GMUG page—

<http://www.lerc.nasa.gov/WWW/AdvisoryGroups/MUG/>

Public GMUG page—

<http://GMUG.grc.nasa.gov>

MacCentral articles on Macs in Science and Engineering:

<http://www.maccentral.com/news/0008/09.tech.shtml>

<http://www.maccentral.com/news/0008/08.resurging.shtml>



## Check us out on the web!



<http://www.lerc.nasa.gov/WWW/AdvisoryGroups/MUG/>



**What A  
Great  
Crowd!**



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# Construction and Performance of an Apple Macintosh G4 Cluster

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## **Abstract**

The construction of a 28-processor Apple Power Macintosh G4 cluster is described and its performance is compared to that of an existing SGI Octane cluster. The Macintosh cluster is tested using an existing high-accuracy computational aeroacoustics code. The results show that the Macintosh cluster is a simple and cost-effective approach to parallel processing.

## **Introduction**

As computers have improved in speed and memory over the last decades, the cost of conducting complex, large-scale calculations has decreased rapidly. It is now to the point that low-cost personal computers (PC's) can be clustered to efficiently solve problems that were beyond the reach of the most expensive supercomputers of a decade ago. One popular method of constructing such a cluster of PC's is the so-called Beowulf design, in which Intel processors are run in parallel using the Linux operating system<sup>1</sup>. Two examples of this method are the COCOA cluster at Penn State university<sup>2</sup> (25 dual-processor 450 MHz Pentium III machines) and the Aeroshark cluster at NASA Glenn Research Center<sup>3</sup> (64 dual-processor 600 MHz Pentium III machines).

Another method which is being developed is the Appleseed design, formulated from UCLA<sup>4</sup>. The Appleseed method uses Apple Power Macintosh computers and retains the Macintosh operating system, allowing the computers to be utilized as ordinary desktop machines when not running parallel computing jobs. Another advantage of the Appleseed method is the simplicity of constructing and maintaining a cluster of this type.

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## **Construction and Cost of the Macintosh Cluster**

The construction of the ICOMP Macintosh cluster was straightforward. A total of 2 single-processor 400 MHz G4's (\$1739 each) and 13 dual-processor 450 MHz G4's (\$2957 each) were purchased, each machine having 320 MB of memory per processor. To connect the machines, a 3Com SuperStack II 3300 switch (\$1680) was used, for a total hardware cost of \$43,599. Along with this, the Absoft F90/95 compiler was purchased (\$919), bringing the total cost to \$44,518. The MacMPI and Launch Puppy/Launch Den Mother software was downloaded from the UCLA Appleseed web site (<http://exodus.physics.ucla.edu/appleseed/appleseed.html>), and placed on each machine.

The elapsed time from unpacking the machines to running an existing parallel computational aeroacoustics code on all 15 nodes was 14 hours, of which 8 hours were spent making connecting cables and configuring the switch. Using the documentation from UCLA, each machine took approximately 10-15 minutes to configure once started. From the first code run, the Macintosh cluster ran flawlessly.

## **Code Implementation Details with the Macintosh Cluster**

To test the Macintosh cluster, an existing high-accuracy computational aeroacoustics code was ported from the ICOMP SGI Octane cluster. This code is a compressible, viscous, three-dimensional solver using a block-structured curvilinear coordinate approach for complex geometries. The solver uses a prefactored sixth-order compact scheme<sup>5</sup> with tenth-order explicit filtering<sup>6</sup>. The time marching uses the explicit, optimized Low Dispersion and Dissipation 5-6 scheme of Hu, et. al<sup>7</sup>, with the low-storage technique of Stanescu and Habashi<sup>8</sup>. This method has been extensively validated on benchmark CAA problems<sup>9-11</sup>.

The code itself is written in Fortran 90, using derived data types and dynamic memory allocation for computational efficiency. The Message Passing Interface (MPI) is used for communication between nodes; for portability, only MPI-1 commands are used. In order to parallelize the code, the grid is automatically decomposed into smaller blocks, which are distributed evenly between the processors. Since the compact differencing is implicit, and hence requires the spatial derivative from neighboring blocks to find each spatial derivative, an optimized explicit difference is used at the interior boundaries of each block. In this way, only a single message pass is required for each spatial derivative and high accuracy is retained. This method is discussed in detail in Ref. 5.

In porting this code to the Macintosh, the code had to first be compiled using the Absoft compiler. This was relatively easy, since the Absoft and SGI compilers both are developed from the Cray Fortran 90 compiler. There was one extra compilation option required for the Absoft makefile; the compiler returned an error message suggesting this option.

For parallel message passing on the Macintosh operating system, MacMPI was developed at UCLA. MacMPI is a partial implementation of MPI-1, translating the MPI calls to Apple Open Transport calls which use the message passing commands that are already in the Mac OS. The communication performance of MacMPI between two processors was compared to the performance of the ICOMP SGI cluster (3 dual-processor Octane 250 MHz MIPS R10000 and 3 dual-processor Octane 270 MHz MIPS R12000 machines) as well as the Aeroshark Linux Beowulf cluster using the program 'pingpong.f', available at <http://exodus.physics.ucla.edu/appleseed/other.html>. The results are illustrated in Figure 1. Note

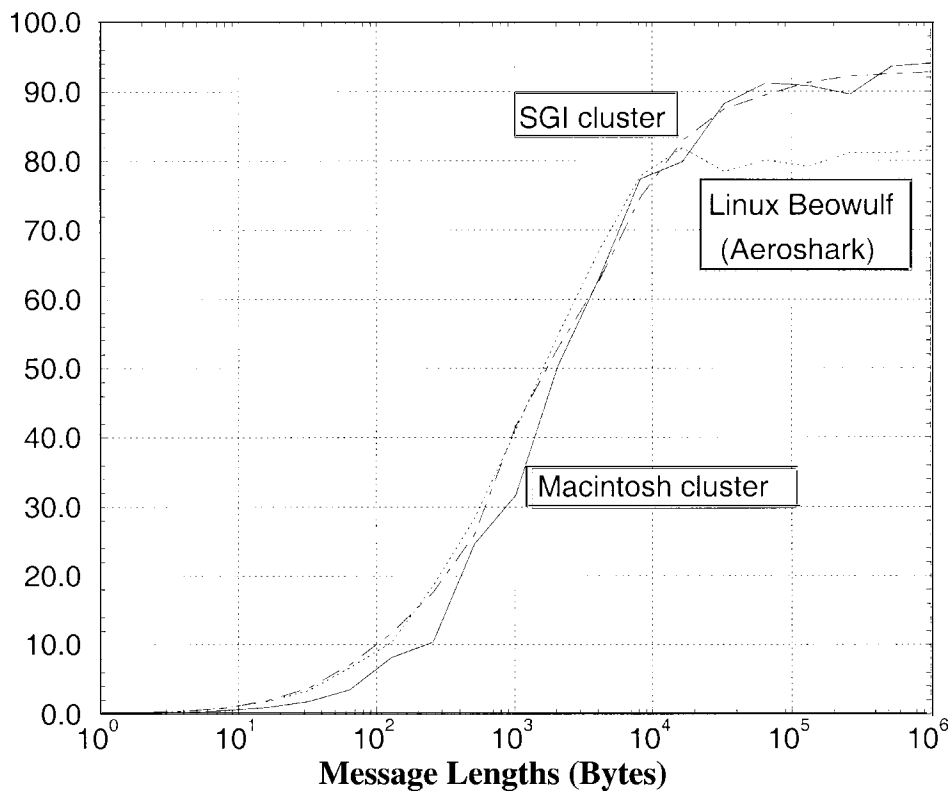


Fig. 1: Comparison of MacMPI Communication Performance with SGI and Linux Beowulf Machines.

that the MacMPI performance is very comparable to the full MPI implementations of the SGI and Linux clusters.

There is one point to be aware of in the MacMPI implementation: no buffer space is allocated for storing the incoming MPI messages. Thus, between two nodes the message receives on one node must be called in the same order as the message sends were called on the other. This was not necessarily true of the current implementation of the computational aeroacoustics code — if there is more than one block on a node, the message sends and receives

may be out of order. To avoid this problem, the test problem has one block per node. In the near future, the code will be rewritten to have only one large message pass between nodes instead of a message pass for each buffer. This will improve the code's efficiency on all platforms as well as making it completely MacMPI compliant.

### **Parallel Scalability Tests**

In these tests, the sixth-order CAA code is applied to the benchmark test problem of a cambered Joukowski airfoil in a 2-D vortical gust. The input grid is a single block C-grid with 145,200 points. Tests were conducted on both the ICOMP SGI Octane cluster and the ICOMP Macintosh cluster using identical grid and input files. For all cases, double precision real variables were used throughout the code.

The total grid was held fixed through this test, and was decomposed one block per processor. For the SGI cluster, the tests ranged from one to twelve nodes, with the first six being the faster R12000 processors. For the Macintosh cluster, the tests ranged from one to fifteen nodes, with the first and last nodes being the slower 400 MHz processors. Since the Absoft compiler does not currently support the Macintosh dual-processor configurations, only one processor per machine was used. In the first quarter of 2001, a multi-processor compiler which supports the OpenMP library is expected from Absoft; thus, the Macintosh cluster could then use all 28 processors with no code modifications.

The timings were taken using the Fortran 90 DATE\_AND\_TIME intrinsic, and the best timing from the first ten time steps was used. While the SGI machines returned timings to the

millisecond, the Macintosh machines only gave integer seconds. Thus, there is some uncertainty associated with the timings, which will be quantified in the text and figures.

First, the code was run on a single processor to obtain a baseline. The SGI R12000 machines took 41.3 seconds per time step, while the Macintosh 400 MHz machines took between 40.5 and 41.5 seconds per time step.

Figures 2 and 3 show the results from this series of tests. In Figure 2, the CPU time per time step is plotted against the number of processors used. The error bounds for the Macintosh timings are shown, as well as the exact timings for the SGI cluster. Note that both clusters are initially giving superlinear speedups, and the Macintosh cluster continues to give superlinear speedups throughout the tests. It is conjectured that superlinear speedups results from the smaller block sizes allowing better data management as more processors are added. Figure 2 also shows a decline in performance from the SGI cluster when more than six processors are used;

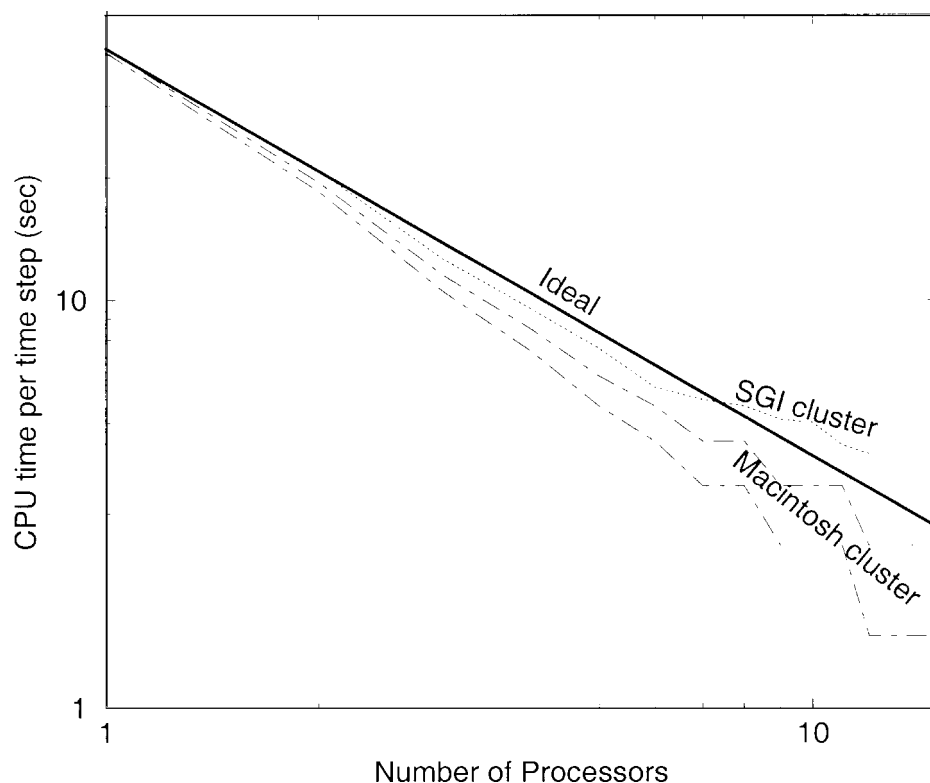


Fig. 2: Parallel Scalability Comparison of CAA code on SGI and Macintosh Clusters Using CAA Code.

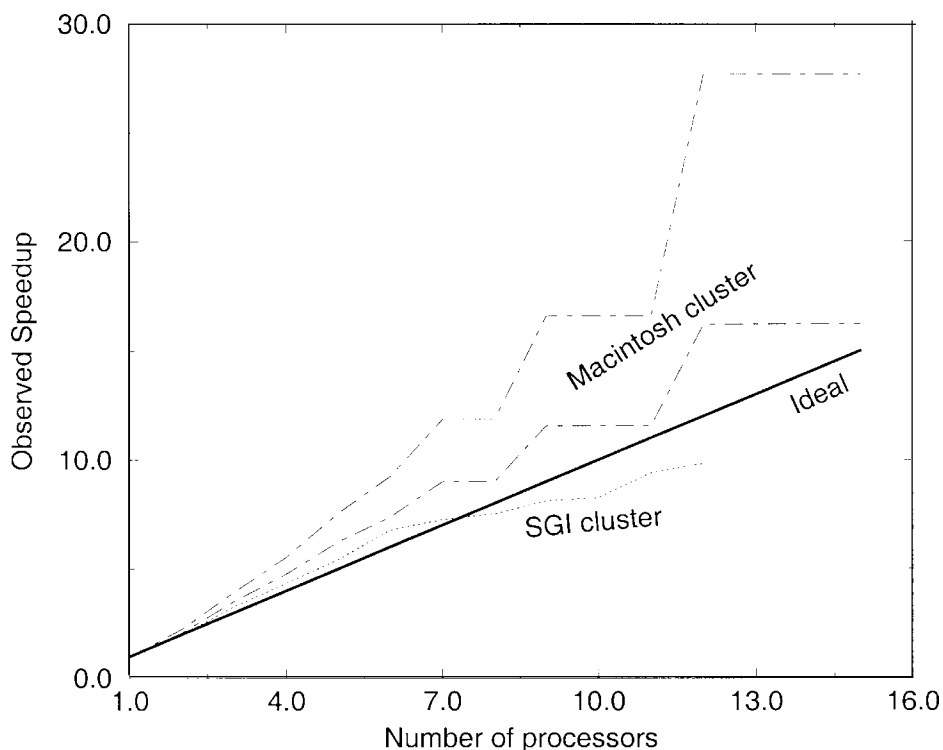


Fig. 3: Observed Speedup of CAA Code on SGI and Macintosh Clusters Using CAA Code.

the first six processors are the faster R12000 CPU's, and the slower R10000 CPU's are added after that.

Figure 3 shows the observed speedup as a function of the number of processors used. Again, the error bounds for the Macintosh cluster are shown. It is seen that the Macintosh cluster outperforms the SGI cluster for all tests, and that the performance has not degraded with the fifteen processors used.

### **Conclusions**

The construction of an Apple Power Macintosh G4 cluster has been described, and its performance compared to that of an existing SGI Octane cluster. The performance tests were conducted using an existing computational aeroacoustics code written in Fortran 90 and using MPI, with no modifications made for either platform. The Macintosh cluster was low-cost and very easily constructed and configured; since it utilizes the Macintosh operating system, it will also be easily maintained. The numerical tests show that the floating-point and communication performance of the Macintosh G4 rivals that of an SGI workstation cluster which costs much more. From these tests, a Macintosh cluster is a low-cost, high-performance parallel supercomputer.

### **Acknowledgment**

The authors would like to thank Dr. Ted Keith for his support of parallel clusters at ICOMP, and Dr. Viktor Decyk, Dean Dauger, and Pieter Kokelaar of the UCLA Department of Physics for their development of MacMPI and their advice and suggestions during this work. No support was requested or received for this work from Apple Computer Corp. or Absoft Corporation. Macintosh and Power Macintosh are trademarks of Apple Computer Corp.

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## Cool Sites

### The Glory Of Yesteryear

In the midst of all the attention paid to OS X, it's easy to forget those still struggling on with Macs not up to the task of this brave new OS. As a public service, we examine some resources for entertainment titles best suited to these older machines.

Complete story:

[http://www.macaddict.com/cgi-bin/redirect.cgi?inside\\_sources=1&target=http%3A%2F%2Fmacaddict.com%2Ffun%2Fgames%2Fclassics.shtml](http://www.macaddict.com/cgi-bin/redirect.cgi?inside_sources=1&target=http%3A%2F%2Fmacaddict.com%2Ffun%2Fgames%2Fclassics.shtml)

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### A Look At File Types And Creators

While you're waiting for your copy of the OS X Public Beta to arrive in the mail, it never hurts to brush up on the inner workings of what will soon become the Classic environment. RexExcellence helps with an excellent tutorial on file type and creator codes.

Complete story:

[http://www.macaddict.com/cgi-bin/redirect.cgi?inside\\_sources=1&target=http%3A%2F%2Fwww.ResExcellence.com%2Fhack\\_html\\_00%2F09-1300.shtml](http://www.macaddict.com/cgi-bin/redirect.cgi?inside_sources=1&target=http%3A%2F%2Fwww.ResExcellence.com%2Fhack_html_00%2F09-1300.shtml)

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### The Command-Line Jockey's Guide To The OS X Public Beta

When Apple bundled up the BSD portions of Mac OS X, they left out all the development tools. If you know UNIX, you're probably already cringing at the thought. Here's how to fix things up.

Complete story:

[http://www.macaddict.com/cgi-bin/redirect.cgi?inside\\_sources=1&target=http%3A%2F%2Fwww.macaddict.com%2Fcontent%2F%2Fnews%2F%2F2000%2F09%2F13%2F18709](http://www.macaddict.com/cgi-bin/redirect.cgi?inside_sources=1&target=http%3A%2F%2Fwww.macaddict.com%2Fcontent%2F%2Fnews%2F%2F2000%2F09%2F13%2F18709)

# Cool Sites (Cont'd)

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## Where To Get OS X Public Beta

If you've decided to take the Mac OS X Public Beta plunge, we have the straight scoop on where to get it and how much it'll cost you. Plus, we'll show you where to get support and tell Apple what you think of the latest and greatest

Complete story:

[http://www.macaddict.com/cgi-bin/redirect.cgi?inside\\_sources=1&target=http%3A%2F%2Fwww.macaddict.com%2Fcontent%2F%2Fnews%2F%2F2000%2F09%2F13%2F18692](http://www.macaddict.com/cgi-bin/redirect.cgi?inside_sources=1&target=http%3A%2F%2Fwww.macaddict.com%2Fcontent%2F%2Fnews%2F%2F2000%2F09%2F13%2F18692)

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## Mac OS X: Included Applications

One of the things that separates the operating system survivors from the ones that don't see the next morning is how much software is available. Besides being able to run almost every Mac OS 9 application, Mac OS X also ships with a number of great programs.

Complete story:

[http://www.macaddict.com/cgi-bin/redirect.cgi?inside\\_sources=1&target=http%3A%2F%2Fwww.macaddict.com%2Fcontent%2F%2Fnews%2F%2F2000%2F09%2F13%2F18677](http://www.macaddict.com/cgi-bin/redirect.cgi?inside_sources=1&target=http%3A%2F%2Fwww.macaddict.com%2Fcontent%2F%2Fnews%2F%2F2000%2F09%2F13%2F18677)

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## PowerBooks and Mac OS X

Although Mac OS X has been associated with raw power ever since it was announced, it makes a great operating system for the latest PowerBooks, too. With solid power management and wake-up times that beat up on Mac OS 9, you'll be pleasantly surprised with Mac OS X on your 'Book.

Complete story:

[http://www.macaddict.com/cgi-bin/redirect.cgi?inside\\_sources=1&target=http%3A%2F%2Fwww.macaddict.com%2Fcontent%2F%2Fnews%2F%2F2000%2F09%2F13%2F18689](http://www.macaddict.com/cgi-bin/redirect.cgi?inside_sources=1&target=http%3A%2F%2Fwww.macaddict.com%2Fcontent%2F%2Fnews%2F%2F2000%2F09%2F13%2F18689)

## For Sale

My son is selling his Compaq (he now has an iMac DV SE). It is a 166 MHz, Pentium, with 48 mb of RAM, a 1.2 gb hard drive, a 56k internal modem, an 8 speed CD Rom drive, and a 15" color monitor. Also included is a *NEVER USED* Epson color printer (still new sealed in the box). Asking \$350. Call me if interested. Lisa Madden x9815 (Lisa.Madden@grc.nasa.gov).

# Apple MUG Store

Reviewer: Melissa McGuire (melissa.mcguire@grc.nasa.gov)

Subject: Ordering Items from the Apple MUG store

Company: Apple and PowerMax

Web Page: <http://www.applemugstore.com/>

Summary (from their web site):

*The Macintosh User Group (MUG) Store is a special program for Apple User Group members only. If you are an Apple User Group member, you can use the MUG Store to purchase Apple factory refurbished computers, used and pre-tested Mac equipment, special offers from third party vendors, closeout or discontinued merchandise and Apple logo merchandise*

In trying to find out neat perks and deals for our MUG members, I have found the Apple sponsored MUG store. See the URL and description above.

Recently, I gave the Apple MUG store a try and ordered an open box model of Apple's Airport Base Station for my own home use. They had a great deal and I'd earn points for our MUG. I have placed my order and am awaiting delivery of my new Base Station. I have an iBook at home, and finally bought an Airport Card. Now I get to actually try out the wireless networking everyone's talking about.

Ordering from the Apple MUG store was a snap. I talked to a very helpful gentleman named Joe [joe@powermax.com]. Feel free to email him if you're interested in any of these deals. He explained to me what "open box" actually meant. PowerMax is an apple only reseller in the Portland, Oregon area, and Apple chose them to ship out the MUG store items.

Most items in the store are older equipment at pretty good prices. Most likely these are items in Apple's warehouses that they want to get rid of, or items that have been returned or refurbished. The prices on new models are pretty much what you'd pay through the catalogs or through Apple's store itself. However, if you order from here, and mention the Glenn Mac Users Group (we are officially registered as an Apple MUG), then the MUG earns points toward the purchase of Apple stuff.

So if you're in the market for something Apple, you might want to give the MUG store a try. Contact me for the username and password to enter the store. (melissa.mcguire@grc.nasa.gov) I'll report in once I receive the Airport Base Station and let you know how it all went.



## WANTED

An article by you for the  
GRApple Newsletter.

Send all reviews, tips, articles, to  
Lisa Madden, Editor at:

**Lisa.Madden@grc.nasa.gov**

***Don't make me come lookin' fer ya.***

# TIPS

and

# TRICKS

## KEEP COOL, POWERBOOK BABY

Riddle me this: What freezes when it gets hot? Well, it's likely your Powerbook, chief. If you work long hours on a Powerbook and have trouble with it randomly freezing or crashing, you may just need to get it some air.

To avoid overheating, set your open Powerbook on something elevated so that air can get underneath. Try an upside down wire-style "In" box, for example.

Or four blocky art erasers. The Design Artgum brand works fabulously.



## KEEP COOL, TWO

We've talked about how a heavily-used Powerbook can get hot and start acting cranky. Here's another tip about preventing such unruliness.

If you use an external monitor and keyboard, you can show off your Powerbook and cool it off at the same time. Just fold it until it's only about 30% open and stand it on it's end, A-frame style. This also gives you better access to the backside ports, since they're now on top.

## APPEARANCE IS EVERYTHING

Is your desktop giving you the yawns? Well, don't waste another minute! Head over to:

MacDesktops.com  
<http://www.macdesktops.com/>

Here, you'll find a fantabulous selection of images to suit your particular mood or style. Handy directions for redecorating are right there, too. In no time, you can have a marvelous Mac-centric desktop like this one:

<http://macdesktops.com/images/800x600/MTDontThink800x600.jpg>



**Got some old, but still usable, Macintosh equipment and/or peripherals collecting dust at your house? Well, whatcha waiting for? Who needs e-Bay? Send me your "For Sale" list, complete with asking price, condition (photo if you have it), contact information, and I'll place an ad in an upcoming issue of our newsletter — FREE.**

**Lisa.Madden@grc.nasa.gov**